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Mleke, Mpawe Nicodem

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A Web-based Monitoring and Evaluation System for Government Projects in Tanzania: The Case of Ministry of Health

Mpawe Nicodem Mleke

School of Computational and Communication Sciences and
Engineering
The Nelson Mandela African Institution of Science and
Technology
Arusha, Tanzania
mlekem@nm-aist.ac.tz

Mussa Ally Dida

School of Computational and Communication Sciences and
Engineering
The Nelson Mandela African Institution of Science and
Technology
Arusha, Tanzania
mussa.ally@nm-aist.ac.tz

Abstract—Monitoring and evaluation systems are used by organizations or governments to measure, track progress, and evaluate the outcomes of projects. Organizations can improve their performance, effectiveness, and achieved results in project success by strengthening their monitoring and evaluation systems. Moreover, various studies reveal the need for information and communication technology systems in monitoring and evaluation activities. Despite the advantage of the tools, most organizations do not employ computerized monitoring and evaluation systems due to their cost and limited expertise whereas those having these systems lack a systematic alert mechanism of the projects' progress. Currently, the Ministry of Health, Community Development, Gender, Elderly, and Children of Tanzania monitors and evaluates its projects manually facing the risks and consequences of delayed project completeness. In this study, the evolutionary prototyping approach was used to develop the proposed system. This study describes the development of a web-based monitoring and evaluation system that aims to solve the monitoring and evaluation challenges, simplify works, generate quality data, and provide timely successful project implementation. The developed system was tested and evaluated against the user's requirements and was positively accepted to be deployed at the Ministry of Health.

Keywords—health projects, monitoring and evaluation system; web-based, Ministry of health

I. INTRODUCTION

Monitoring and Evaluation (M&E) systems are used to improve the performance of projects and achieve positive results in project activities. M&E is essential in helping planners, implementers, managers, policymakers, and donors to understand and obtain the information they need to make informed assessments about project processes or operations [1]. Project activities are usually executed over a fixed period of time, with the aim of achieving desired outcomes or specific goals [2]. Project monitoring is essential for giving feedback about project progress to the beneficiaries involved in the project, implementers, and the donors who fund the project. Furthermore, project evaluation is necessary for making

judgments about the activities of the project and informing program decisions. Evaluation determines the efficiency, effectiveness, sustainability, impact, whether projects have met their targets, and helps to identify areas of improvement. Moreover, by sharing the project output to others, M&E creates knowledge in project management and promotes accountability to donors, stakeholders, and citizens [3]. The Tanzanian government has recently shown significant efforts in improving the lives of its citizens, by initiating and implementing different projects and programs in community empowerment and health [4]. In Tanzania, the basic health care services are equitable, qualitative, affordable, accessible, gender-sensitive, and sustainable and are supposed to be taken care by the Ministry of Health, Community Development, Gender, Elderly and Children (MoHCDGEC). Projects initiate at MoHCDGEC, but there is a lack of M&E systems for tracking their implementation progress in order to improve data quality, performance, reduce paperwork, and achieve good results.

II. BACKGROUND INFORMATION

Currently, M&E of government projects at the MoHCDGEC is done manually, and as a result, there are risks encountered due to the lack of timely adoption of remedial actions. Non-uniformity is observed in data collection, reporting, and management for different projects sponsored by different donors within the Ministry [5]. Having an electronic system for providing accurate and timely M&E information can be one of the solutions to this problem. Among the challenges faced by the National Malaria Control Program (NMCP) was coordinating the collection of M&E information [6]. Moreover, lack of coordination among partners, agencies, ministries and information communication and technology departments was highlighted in the Health Sector Strategic Plan III (2009–2015). The strategic plan further showed a lack of M&E activities in epidemics such as AIDS/HIV, tuberculosis (TB) and malaria due to poor infrastructure of the healthcare system and inefficiencies [7]. Although the donor-funded health projects reported an increasing demand on the use of electronic M&E systems to reduce workload, improve data

quality, data analysis, accurate reports, and data access [7], such systems are not available at the Ministry of Health. This study intends to support the MoHCDGEC by developing an electronic M&E system for government projects in order to track progress, report status, and give alerts and warning information. Moreover, this study will simplify the data collection process, generate qualitative data for planning and evaluation, facilitate successful project implementation, and provide feedback mechanisms between stakeholders, employees, and donors.

III. RELATED WORK

M&E assists governments and organizations to extract data from past and ongoing activities, provides reports on projects' progress, and measures whether the project is meeting its objectives or progressing in the right direction. Without M&E, it is impossible to judge if the project work is going in the right direction and what future efforts might be required [1]. Traditionally, M&E focused on assessing input with the implementation processes. Today, M&E focuses on assessing the factors that contribute to the development output, outcome, partnerships, advocacy, coordination, and policy advice. Project managers are required to apply the information gained from M&E to improve project activities and strategies. Better decisions in projects lead to greater accountability to the stakeholders and help improving project activity performance. Close partnership with stakeholders creates knowledge sharing, skills, learning, capacity, project decision planning, provides valuable feedback, and makes a positive contribution to the effectiveness of development [1]. A project can be successful by good decision making and cooperative relationships [8]. Having project planning and project management teams keeps the judgment of ongoing project activities, monitors progress, solves the challenges in case of gaps in planned goals, and improves project performance. The performance of a project is influenced by project management capabilities, cost, quality, time, risk management, communication skills, and human resources [9]. An UNESCO report indicates that governments or organizations have the systems for data collection for measuring the outcomes which have achieved on a project or program and can be simple or sophisticated but their results are poor due to lack of electronic M&E systems. It further shows that in the developed world only a few countries are implementing projects by using M&E systems [10]. Authors in [11] proposed an M&E system for the organization and employee evaluation for the Ministry of Trade and Industry in Egypt. The system, not only provided regular reports but also assisted the top management to get feedback from employees and customers, eventually increasing employee performance. In [12], a web-based tool was used to support the collection and reporting of data for learning, research, and teaching in education. The tool was needed by students, instructors, and researchers for education project design, student progress evaluation, and as a feedback tool. This tool can be adopted at the MoHCDGEC to simplify the implementation of health project activities and provide feedback to different stakeholders.

Authors in [13] studied web-based construction for projects and a tool to monitor their performance was developed to

support the project manager to measure and manage people, time, client satisfaction, cost communication, and quality. The purpose of this tool was to reduce the time used to collect data, dissemination and data incompatibility that was occurring in different software or systems. However, the system had cost implications in ensuring reliable security, preventing downtime and facilitating constant monitoring. The developed M&E system in [14] allows monitoring and evaluating road projects and public works for Philippines government. The information is being secured and cannot be deleted or altered because of the administrator who updates and edits the data. The Sokoine University of agriculture in Tanzania has developed a web-based M&E system. The adoption of this electronic system helps knowing project progress, learning from achievements, coordinating and managing the project activities. Overall, the designation of this system helps detecting risks that may occur and it gives early warnings to the coordination office and project's team members. That system has additional functionalities allowing researchers and project team members to submit their reports electronically [15].

The literature review reveals that most government/organizations do not employ computerized M&E systems and those having these systems lack a systematic early informing mechanism of the projects' progress. This study aims to develop a web-based M&E system for health projects in order to keep track of the implementation progress, report the project status, and give appropriate warning alerts thus contributing to the completion of the project's goals.

IV. METHODS

A. System Development Approach

In this study, data were collected at the MoHCDGEC in Dodoma and Dar es Salaam regions, where various projects are monitored and evaluated. Interviews, document reviews and focus group discussions were used to analyze the current M&E system for government projects. The requirements for the proposed system were analyzed and participants agreed to have an electronic M&E system for government projects in Tanzania. To develop the proposed system for government projects, the evolutionary prototyping approach was used because it allows changes in every phase [16]. It improves the prototype system, reduces the software risks, minimizes work, and critical and serious defects during the system testing.

B. Tools and Technologies Used in System Development

1) Hypertext Pre-Processor (PHP)

It used for database connection and manipulation and carries website duties such as authentication, password handling, and forum managing. It can be embedded into Hyper Text Markup Language (HTML) code [17]. In this study, PHP was used to accept the data from the client and send them to the Relational Database Management System (RDBMS) for storage. It ensures the security of the user who logs in by maintaining the user session across the pages. Further, it was used to connect the developed system to the MySQL database.

2) MySQL

It is a back-end RDBMS that handles database commands or instructions. It handles large databases efficiently by employing different programs to support the administration [18]. During this study, a MySQL database was developed to help M&E and other project members to store, retrieve and manage data. Furthermore, different access privileges and password encryptions were used to enhance security through host-based verification.

3) Javascript

It is a scripting language that allows client-side data validation before the data are submitted to a database. The client-side validation is important as it saves time, reduces the workload of the server, allows the server to concentrate on low-level verification and data processing [10]. In this study, apart from validation, JavaScript libraries such as JQuery and Chart.js were employed to improve data presentation in plotting graphs, and handling tabular data and the date text field.

4) HyperText Markup Language (HTML)

In the development of this system, HTML [20] was used for the purpose of displaying the web pages and other multimedia/information which are displayed on a web browser.

5) Apache Web-Server

It is highly customized to meet the need for different environments by using modules and extensions. Apache is a cross-platform software that works on both Windows and UNIX servers, it is reliable, secure, and fast [21].

6) Integrated Development Environment (IDE)

For this study, the IDE used was Net Beans. It is an open-source integrated development environment used for application development. It provides the wizard, editors, and templates which help creating applications in programming languages like PHP and Java and can be installed in operating systems such as Windows, macOS, Solaris and Linux [22].

C. User Acceptance Testing

User acceptance testing was conducted to validate the proposed system if it met the project's requirements at MoHCDGEC. Questionnaires were given to twelve respondents including four M&E staff, two ICT staff, four project members, one project manager and one Accountant to gather feedback on the validity of the system.

V. RESULTS AND DISCUSSION

A. System Requirements

For implementing the proposed system, functional and non-functional requirements were collected and are shown in Table I and Table II respectively.

B. The Architecture of the Proposed System

Based on the study findings, the proposed system was successfully developed. It contains three modules: a project registration module, a project tracking module, and a project status module. This study intended to develop a tool to track

and report the status of projects and allow prompt actions to mitigate the encountered challenges and risks. Figure 1 presents the architecture for the proposed system.

TABLE I. FUNCTIONAL REQUIREMENTS

System users (actors)	Description
System administrator	Will be able to login to the system and register all users/members. Is responsible for defining and giving different privileges to the users of the system, for maintaining, and for updating the system. Every user must have a username and password.
Project manager	Will be able to register a new project to the system, including code number and title/type of project, location and timeframe/period of the project, source of the project fund and all partners/support/donor funds and project activities.
M&E officers	Add/update indicators for project activities and targets of the project, in a quarterly or year basis. M&E will review and check the data which are entered by program members to track the progress of the project and to measure performance and generate quarterly or yearly reports depending on the nature of the project.
Accountant officers	Add/update financial documents for project activities and verify if the accounting function was correctly captured.
Project members	Program members or project teams will have the privilege to perform their specific tasks of entering data/information in weekly, monthly or quarterly basis.
All registered users	Users will be able to view the deadline warnings, the status and report of the projects and alert information before/after the project is completed.
Donors/ partners	They will be able to provide feedback from the generated report. Further, they will view various reports from the projects they support. They can see the progress of reports and enquire more information from the project manager if needed

TABLE II. NON FUNCTIONAL REQUIREMENTS

Quality factor	Description
Performance	The system will be required to support many terminals simultaneously without failure and handle multiple users without contradiction or break by using a fast server to handle traffic and provide cross-browser compatibility.
Usability	Users must be satisfied with the usability of the website without any specialized training and be able to complete different tasks without failure.
Reliability	The system should be capable of maintaining its performance..
Security	The system will protect services and information from external attacks using authentication, authorization, and encryption.
Interoperability	The system will be interoperable with existing systems at the ministry. Other systems must be able to fetch data from it and it should be able to read structured documents such as XML.
Maintainability	The maintenance or any modification to the system will not cause the website to shut down more than once in 24 hours.
Recovery	The system will be able to recover after some damages.
Flexibility	The system will have the ability to add the new notification/status of projects before and after the deadline

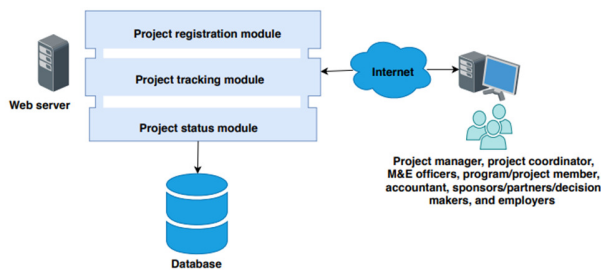


Fig. 1. Architecture of the proposed system.

C. Data Flow Diagram

The dataflow diagram is used to show how data will flow between actors [23]. In this study, the level 0 (context diagram) shows the flow of information between the developed system and external entities (Figure 2). Data flow diagram (Level 1) presents the flow of information for all processes involved in each stage and their stored data when the process is completed. Figure 3 presents the data flow diagram for the developed system.

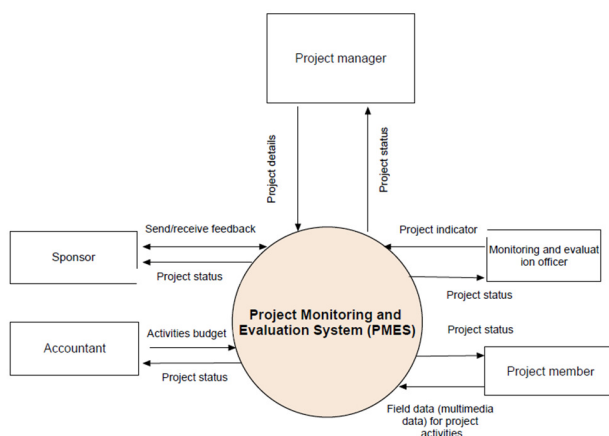


Fig. 2. Context diagram.

D. The Developed PMES

The developed web-based tool, named Project M&E System (PMES) for government projects is organized into six sections, namely account, settings, project details, project implementation, reports, and system log. These sections grouped several functionalities to simplify navigation. The developed web application for government projects allows only registered users to access the system. The home or dashboard page shows the status of the projects/project information including the initiated, implemented, completed, delayed projects and alert/warning information displayed on the dashboard. The dashboard page (Figure 4) helps all system users to understand the progress of each project and minimize potential problems or solve the project challenges on time. This will help the Ministry of Health to complete projects within the allocated time. All registered system users can view the status of the project, but not other system menus. Registered users need the administrator's permission to access other menus

based on their user roles. In the PMES, only system administrators can browse and access all system menus. The project detail section, has various functionalities including project registration, project sponsors, project members, project activities, and uploaded project reports. Project manager and M&E team have access to the project detail section. To register a new project, the project manager enters the new project details including the title/type of the project, code number, location, start date, end date, and project and project activities. Moreover, the project manager registers the project sponsor, project members, and fills the amount of money sponsored by the project. This is done by selecting their members, donor and positions since they were already registered by the system administrator. Lastly, in the project details menu, project manager and M&E officer can upload various project reports. The reports may include information about project activities at any time they are needed, quarterly, annually or based on the agreed project format. This will allow users to know the reports of various projects and have access to feedback from decision making/ partnership/sponsors. Figure 5 shows the page for entering the project details. The project implementation section enriches the particular project entered in the project section. It houses PMES functionalities including entering field data, setting indicators, entering indicator achievement, setting a budget and finally entering activity expenditure. In the system, the M&E officer is responsible for adding or updating the indicators of project activities on a quarterly basis or depending on the nature of the project. As a part of monitoring, the M&E officer is able to set indicators for each project activity, monitor its progress and enter the score of a particular indicator. Figure 6 presents the form for uploading activity execution attachment.

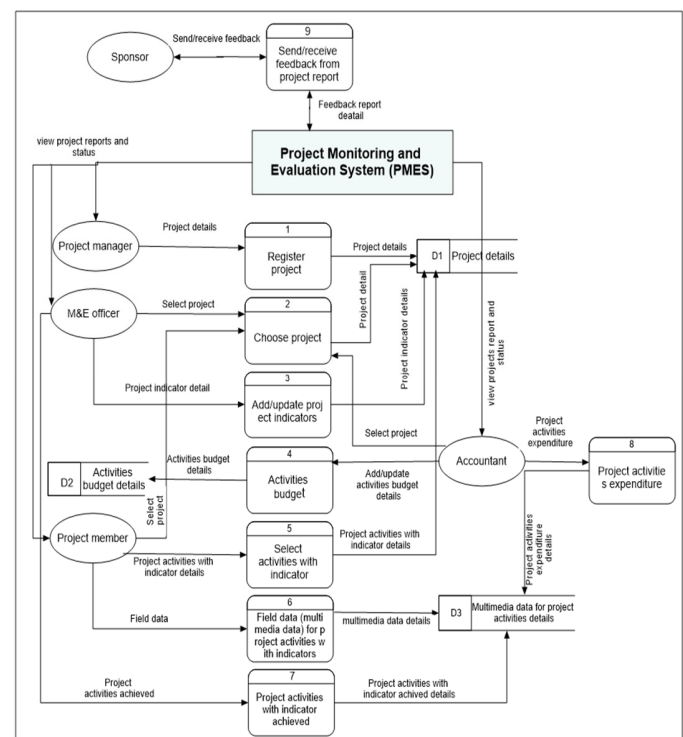


Fig. 3. Data flow diagram.

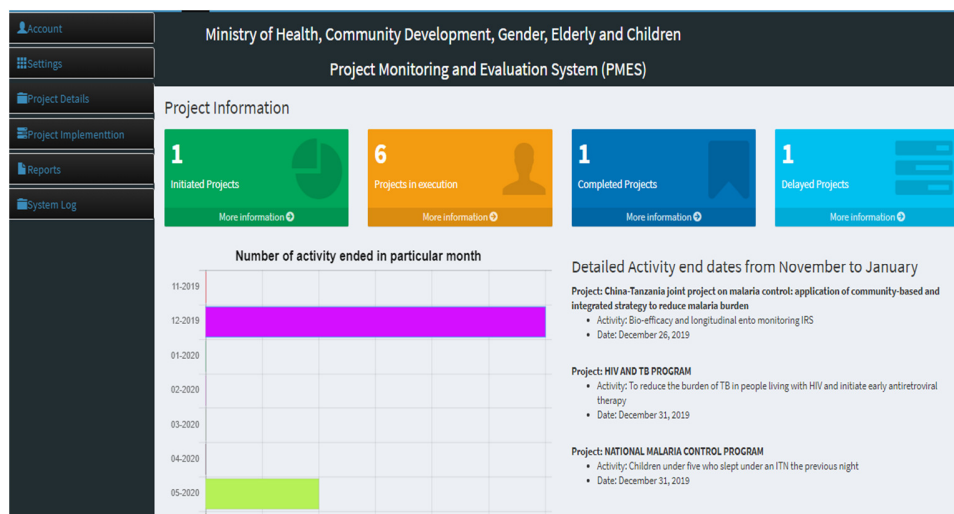


Fig. 4. Dashboard.

Project Management Add / Edit Project

Enter Project information

Project Code
Enter Project Code

Project Title
Enter Project Title

Project Description
[Text Area]

Project Location
Enter Project Location

From Date
Enter Project Starting Date

To Date
Enter Finish Date

Submit **Reset**

Fig. 5. Project details page.

Activity Management Upload Activity Attachment

Upload an Attachment for project **HIV AND TB PROGRAM**

Activity Description
To reduce the burden of TB in people living with HIV and initiate early antiretrovir. ▼

Select File (image) to upload
Choose File TB Registered.PNG

Upload Files that are below 100 KiloBytes

Describe your uploaded file
TB cases registered/confirmed during the quarter

Facility
Maweni Hospital

Location
Kigoma

Submit **Reset**

Fig. 6. Form for uploading an activity execution attachment.

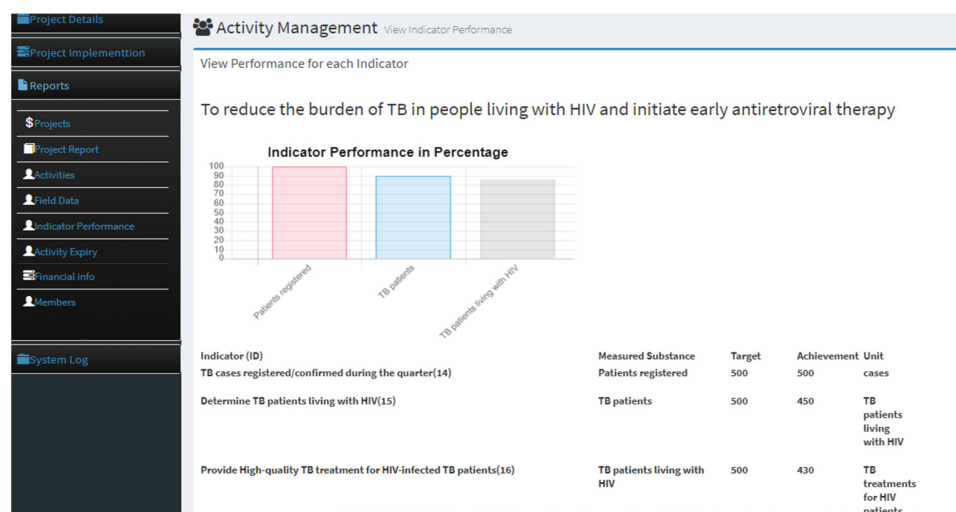


Fig. 7. The indicator performance for project activity.

Project Reports section has the reports needed by the various stakeholders, including reports on project details, field data, indicator performance, activity expiry, financial information, and project members. It is important for M&E officials to monitor the progress of all projects. The indicator performance section offers the M&E team the ability to evaluate the success of activities within the projects. It uses both tabular data and bar graphs to demonstrate the performance of an indicator. While the tabular data present the target and achievement of certain indicators, the graph shows the indicator performance in percentage. Figure 7 presents the indicator performance for project activity.

E. User Acceptance Validation

To gather feedback from the system users, the users were trained in the PMES and were given three days to familiarize with it. The users were then registered into the PMES for proceeding with using and interacting with the system in their different roles. In the project detail menu, the project manager was allowed to log in, reset the account, and register project details. In the project implementation menu, the M&E officer was allowed to login and add the different project performance indicators. The accountant added the budget and sub-budget of the project activities, and the project member uploaded the attachment for activity which has been executed and any needed details or explanation. The other functionalities in PMES included viewing the list of projects with all associated details and status. Furthermore, a questionnaire was distributed to the system evaluators and their comments, views, perception and recommendations about the PMES were asked. The questionnaire results were calculated on the mean score based on a four-point Likert scale (4 = Strongly Agree, 3 = Agree, 2 = Disagree and 1 = Strongly Disagree) as shown in Table III. The mean score for each validated feature was above 3.5 which indicates that the majority of the respondents accepted the developed system, and they will be able to continue using it in their projects in order to improve the project implementation performance. Lastly, the users report that they will recommend the tool or its extensions to fit other minister/organization M&E projects.

TABLE III. SYSTEM'S USER ACCEPTANCE VALIDATION RESULT

Validation Features	Mean score
The PMES satisfies the M&E requirements of health projects.	3.75
The PMES is easy to access.	3.75
The interface of this PMES system is interactive.	3.83
The system contents are learned, understand and easy to operate.	3.75
The PMES will reduce the workload and paperwork in health projects.	3.91
The PMES will improve health project data handling in a specific time.	3.83
The PMES will improve the M&E process of the different health projects on time.	3.75
The PMES will improve the report generation.	3.67
The PMES will be useful and help in accessing health projects at the Ministry.	3.91
I think, I will continue using this PMES.	4
I don't think there is a need for having training support to operate this system.	3.91

F. Discussion

The MoHCDGEC currently relies on manual or paper-based systems in M&E of project activities, revealing a number of challenges in their operation such as poor information sharing and underperformance. Some previous studies indicate that there is a need for web-based tools to monitor and evaluate project activities, simplify data collection, accommodate information sharing among stakeholders and improve the projects' performance. After the system's development, the results of user acceptance testing indicate that the developed PMES will help reducing the presented challenges. There is a need for PMES to be adopted at the MoHCDGEC to minimize manual work, improve cooperation among ministry departments, stakeholders, donors and, partners. Moreover, the developed system will improve the quality of data, simplify the process of data collection and improve the progress of projects of the Ministry of Health in Tanzania.

VI. CONCLUSION

In this study, a tool was developed that will help the Ministry of Health to monitor and evaluate various project activities, thus remedying challenges such as delay of data submission during project implementation and data loss which usually occur in the paper-based data collection on a monthly or quarterly basis. The developed system will be useful to different stakeholders including project managers, project members, decision-makers, policymakers and M&E officers in tracking the projects' progress, in the health domain as a tool for better and more informed decisions.

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